

UNITED STATES PATENT APPLICATION

FOR

MECHANISM TO CONSOLIDATE HPNA THREE NETWORK  
STATES INTO TWO NETWORK STATES

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## **MECHANISM TO CONSOLIDATE HPNA THREE NETWORK STATES INTO TWO NETWORK STATES**

### **FIELD OF THE INVENTION**

The present invention relates to computer network, and more particularly to the handling of network states in a home phone line network.

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### **BACKGROUND OF THE INVENTION**

Home networks are becoming more common and desirable for connecting computers within a home. One type of home network is the home phone line network which uses telephone lines typically installed in residence homes for communication between computers in the home.

Figure 1 illustrates a home phone line network. The Home Phone Line Networking Alliance (HPNA) has published a specification to standardize the behavior of home phone

line networks. The current HPNA specification is version 2.0 (“HPNA 2.0”). The network comprises a control chip 100. The chip 100 further comprises a Media Independent Interface (MII) 106, a Media Access Control (MAC) 108, and a Physical Layer (PHY) 110.

15 The chip 100 implements HPNA 2.0. The chip 100 receives a signal containing data packets through the telephone wires via a phone jack 102. There is an analog front end (AFE) 104 which processes the signal between the chip 100 and the telephone wires. The chip 100 then processes the packets received in the signal from the AFE 104, and outputs a signal to the Host MAC 112.

20 Under HPNA 2.0, stations in the network supports a 10 megabits-per-second (mbps) data rate and/or a 1 mbps data rate, depending on the network state of the station. Such

stations are referred to as “10M8 stations”. Stations implemented under a previous version of the HPNA specification (“HPNA 1.x”) supported only the 1 mbps data rate. Such stations are referred to as “1M8 stations”.

There are three possible network states for 10M8 stations: V1M2 mode, 1M8 mode,  
5 and 10M8 mode. 10M8 stations in the 1M8 mode transmit only 1M8 format frames, with a private communication (PCOM) field set to 1 or 2. The PCOM is a field in the frame. Its information is used by the PHY 110 in node-to-node communications. The PCOM field is set as follows:

PCOM = 0 refers to a 1M8 station;

PCOM = 1 refers to a 10M8 station functioning in V1M2 mode or 1M8 mode if V1\_DETECTED is not asserted; and

PCOM = 2 indicates a 10M8 station functioning in V1M2 mode or 1M8 mode if V1\_DETECTED is asserted.

The signal, V1\_DETECTED, is described further below.

10M8 stations in the 10M8 mode transmit only 10M8 format frames. 10M8 stations  
in the V1M2 mode transmit either 1M8 format frames to 1M8 stations with a PCOM set to 1  
or 2, or 10M8 compatible format frames to 10M8 stations. The 10M8 compatible frame  
contains a gap within the data frames. This “gap frame” provides interoperability between  
the format frames under HPNA 2.0 and HPNA 1.x.

25 The following equations set forth the three modes possible for a 10M8 station:

V1M2\_MODE := (*not ConfigV1*) and ((*not ConfigV2*) or *ConfigV1M2*) and

(ConfigV1M2 or V1\_DETECTED or V1\_SIGNALLED)

1M8\_MODE := ConfigV1

5           10M8\_MODE := *not* (V1M2\_MODE or 1M8\_MODE)

ConfigV1M2 is a signal which forces a station into the V1M2 mode. ConfigV1 is a  
signal which forces a station into the 1M8 mode. ConfigV2 is a signal which forces a  
station into the V1M2 mode.

10           V1\_DETECTED is a signal which is asserted when a 10M8 station, while in 10M8  
Mode and with Link Integrity Status = DOWN, detects a 1M8 format frame with a PCOM =  
1. V1\_DETECTED is also asserted when a 10M8 station detects a 1M8 format frame with a  
PCOM = 0. The Link Integrity Status indicates whether or not the station is connected with  
another station. If the station is disconnected, then the Link Integrity Status = DOWN. If  
the station is connected, then the Link Integrity Status = UP.

V1\_SIGNALLED is a signal which is asserted when a 10M8 station detects or  
transmits a 1M8 format frame with a PCOM = 2.

20           However, a problem occurs when the PHY 110 supports only the 1M8 and 10M8  
modes, but not the V1M2 mode. This occurs when the PHY 110 does not support sending a  
10M8 compatible frame and replacement of the PHY 110 is not viable.

Accordingly, there exists a need for a network state machine which supports the three  
network states of HPNA 2.0 using only two network states. The present invention addresses  
such a need.

## **SUMMARY OF THE INVENTION**

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The present invention provides a network state machine which supports the three network states of the Home Phone Line Networking Alliance specification version 2.0 (HPNA 2.0) using two network states has been disclosed. When a station is in the V1M2 mode, instead of transmitting this frame in the 10M8 format frame with the gap frame, the frame is transmitted in the 1M8 format frame without any gaps in the frame. With this, the three network state equations of HPNA 2.0 collapses into two equations. With only two network states, the complexity of the network state machine is reduced, and a Physical Layer (PHY) which supports only the two network states may be used.

## **BRIEF DESCRIPTION OF THE FIGURES**

Figure 1 illustrates a home phone line network. The Home Phone Line Networking Alliance (HPNA) has published a specification to standardize the behavior of home phone line networks.

Figure 2 illustrates a preferred embodiment of the MAC 108 in accordance with the present invention.

## **DETAILED DESCRIPTION**

The present invention provides a network state machine which supports the three network states of the Home Phone Line Networking Alliance (HPNA) specification version 2.0 using two network states. The following description is presented to enable one of ordinary skill in the art to make and use the invention and is provided in the context of a patent application and its requirements. Various modifications to the preferred embodiment

will be readily apparent to those skilled in the art and the generic principles herein may be applied to other embodiments. Thus, the present invention is not intended to be limited to the embodiment shown but is to be accorded the widest scope consistent with the principles and features described herein.

5 To more particularly describe the features of the present invention, please refer to Figure 2 in conjunction with the discussion below.

Figure 2 illustrates a preferred embodiment of the MAC 108 in accordance with the present invention. The MAC 108 comprises a Receive Data Path 202, a Transmit Data Path 204, a Distributed Fair Priority Queuing (DFPQ) 206, a Binary Exponential Backoff (BEB) 208, a Link Integrity 210, a Network State 212, a Rate Request Control Frame (RRCF) 214, a plurality of registers and Management Information Base (MIB) counters 216.

The Receive Data Path 202 receives data packets from the PHY 110 and sends data packets to the MII 106. In the preferred embodiment, after each data packet sent by the Receive Data Path 202, another packet, referred to herein as a “frame status frame”, is sent immediately following. The frame status frame contains certain status information required by subsequent processes.

The Transmit Data Path 204, which receives data packets from the MII 106 and transmits them to the PHY 110.

20 The DFPQ 206 and the BEB 208 provide collision resolution. The DFPQ 206 provides collision resolution for the 10 mpbs data rate, while the BEB 208 provides collision resolution for the 1 mpbs data rate. In the preferred embodiment, the PHY 110 will provide a collision detect signal. Either the DFPQ 206 or the BEB 208 will then attempt to resolve the collision.

The Link Integrity 210 monitors the physical network conditions. In the preferred embodiment, the Link Integrity 210 updates a link status bit in a link register. The Link Integrity 210 also sends link packets in accordance with HPNA 2.0.

5 The RRCF 214 sends a RRCF whenever the MAC 108 transitions between data rates. The RRCF is used to perform the rate negotiation function, i.e., to determine what is the data rate to communicate between different stations in a home phone line network.

The registers and MIB counters 216 provides programmability to the MAC 108 and handles error event counting.

The Network State 212 in accordance with the present invention monitors the current mode of the MAC 108, i.e., whether the MAC 108 is operating in the 1M8 mode, the V1M2 mode, or the 10M8 mode.

To support the three network states under HPNA 2.0 using two network states, the three network state equations for V1M2\_MODE, 1M8\_MODE, and 10M8\_MODE, set forth in the Background, are collapsed into two equations. To accomplish this, when a 10M8 station is in the V1M2 mode, instead of transmitting this frame in the 10M8 compatible format, the frame is transmitted in the 1M8 format frame without any gaps in the frame.

Thus, the following equations apply:

$$\text{V1M2\_MODE} = \text{1M8\_MODE}$$

20  $\text{ConfigV1M2} = \text{ConfigV1}$

Using the above equations, the three network state equations set forth in HPNA 2.0 becomes the following:

1M8\_MODE := (ConfigV1 or ConfigV1M2) or (not ConfigV2 and  
(V1\_SIGNALLED or V1\_DETECTED))

10M8\_MODE := not 1M8\_MODE

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The definitions for ConfigV1, ConfigV1M2, ConfigV2, V1\_SIGNALLED, and  
V1\_DETECTED remain unchanged.

In this manner, the three network states of HPNA 2.0 is supported using two network  
10 states. With only two network states, the complexity of the Network State 212 is reduced.  
Also, the PHY 110 which supports only the 1M8 and 10M8 native format frame may be  
used.

A network state machine which supports the three network states of the Home Phone  
Line Networking Alliance (HPNA) specification version 2.0 using two network states has  
been disclosed. When a station is in the V1M2 mode, instead of transmitting this frame in  
the 10M8 format frame with the gap frame, the frame is transmitted in the 1M8 format frame  
without any gaps in the frame. With this, the three network state equations of HPNA 2.0  
collapses into two equations. With only two network states, the complexity of the network  
state machine is reduced, and a Physical Layer (PHY) which supports only the two network  
20 states may be used.

Although the present invention has been described in accordance with the  
embodiments shown, one of ordinary skill in the art will readily recognize that there could  
be variations to the embodiments and those variations would be within the spirit and scope  
of the present invention. Accordingly, many modifications may be made by one of ordinary  
skill in the art without departing from the spirit and scope of the appended claims.